October 1999 Highlights of the Pulsed Power Inertial Confinement Fusion Program

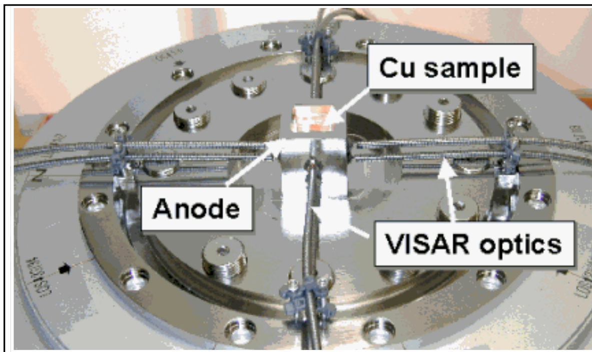

Fig. 1. With this hardware, ~300 kbar peak pressures can be obtained on 8 flat samples.

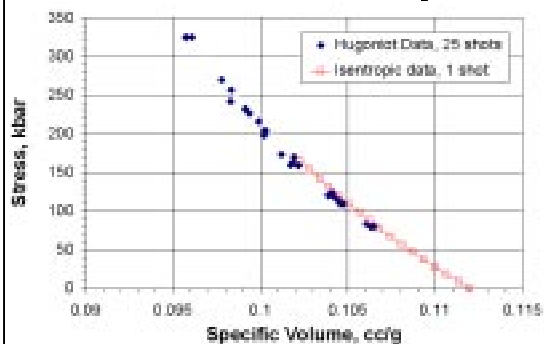

Fig. 2. Pressure-volume response for copper is from velocity interferometer (VISAR) data.

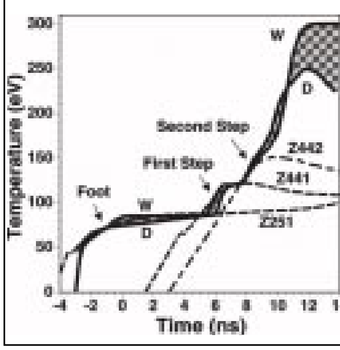

Fig. 3. Temperature profiles for NIF targets compared to Z profiles. Shots 441 & 442 have solid CH foam; 251 has Cu-coated foam. For 251 and 441, hohlraum is NIF-scale (6-mm dia, 7-mm long); for 442, it is 4-mm dia, 4-mm long.

In partnership with LLNL, we are studying the properties of materials used in weapon primaries on Z for Campaign 2 (dynamic materials). Our isentropic compression experiment (ICE) technique (Sept. 98 *Highlights*) uses magnetic compression to produce continuous, shockless pressure loading of flat samples over 100-200 ns. With new hardware (Fig. 1), on which samples are placed on the cylindrical feed of the anode, we can perform eight simultaneous ICEs on a single short-circuit shot. This reduces the cost to obtain equation-of-state data (Fig. 2) to that typical of gas guns and provides added data to validate models for 3-D simulations. The new experimental arrangement allows us to assess the material response to aging and to observe the kinetics of phase transitions, such as melting or refreezing, more effectively than with just two samples. We are developing methods to achieve 1-2% accuracy in velocity data and to increase pressures to 1.5 Mbar by reconfiguring the anode-cathode geometry.

We had 16 Z shots: 2 ICE shots, 4 LANL weapon physics shots, 2 cryogenic D_2 shots, 4 dynamic hohlraum shots, a long-pulse short-circuit shot, and 3 z-pinch-driven hohlraum energetics shots.

On Z we are simulating the “foot” pulse and higher-temperature early pulses without the foot (Fig. 3) required for indirect-drive ignition, using a NIF-style hohlraum (Feb. 99 *Highlights*) driven by x rays from a foam-filled pulse shaping target (PST). A complementary study with shorter pulses is being done on Omega at the University of Rochester. The purpose is to understand the capsule ablator physics before the National Ignition Facility is completed. The x-ray pulse shape is varied using different PSTs inside the z pinch. The interaction of the imploding pinch with the target and the radiation and plasma fields inside the hohlraum are simulated with a radiation-magnetohydrodynamics code and specific aspects are then tested experimentally. The simulations suggest minimal amounts of plasma (~10^{-3} g/cc) fill the hohlraum through the radiation entrance hole between the PST and the hohlraum.

Bechtel/Nevada is measuring the G forces of shocks at various places in Z using “shock master” detectors that trip when a sudden shock is applied. The intent is to monitor mechanical stresses to which diagnostics and structures are subjected in order to have a baseline to scale to the shocks expected with future diagnostics and facilities. Amplitudes of up to 50 Gs (the upper limit measurable with these devices) have been recorded. In the future, new detectors will supply time-resolved, rather than binary, measurements. As part of the study, the University of Wisconsin is doing modeling.

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Archived copies of the *Highlights* beginning July 1993 are available at http://www.sandia.gov/pulspowr/hedicf/highlights.